

REMARKS

Priority

Applicants appreciate the acknowledgement of the claim for priority and receipt of the copies of the certified copies of the priority documents.

Specification

The specification has been amended on page 12 to describe the two catalysts 2 and 3 in the reactor 1 as being in pile form one above the other, as clearly shown in Figs. 1, 9 and 10. Since the amendment only more clearly describes structure already shown in the drawings, the amendment does not contain any new matter.

Claim Rejections Under 35 USC § 103

Claims 14 and 16-19 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over JP 08-0238418 in view of EP 885,648 and JP 61-3040. Claims 14 and 16-20 also stand rejected under 35 U.S.C. § 103(a) as being unpatentable over EP 885,648 in view of JP 08 238418 and JP 61-3040. These rejections are traversed as follows.

Patentability of the Claims

Applicants have amended claim 14 to define an apparatus for decomposing fluorine compounds which contain at least one of PFC, HFC, SF₆ and NF₃ and which comprises only a single reactor and a single heater.

Moreover, claim 14 has been amended to recite additional structure in the

form of means in the reactor for holding the fluorine compound decomposition catalyst and means in the reactor at a portion downstream of where the decomposition catalyst is charged into the reactor, for holding the harmful compound removing catalyst, whereby the two catalysts are contained in the reactor in pile form.

It is further noted that in the amendment filed May 3, 2006, applicants amended claim 14 to define a "harmful compound removing catalyst having a reaction temperature of 650-850°C." In the Office Action of October 31, 2006, the Examiner did not cite any of the references as disclosing this temperature limitation of 650-850°C.

In the invention as now claimed, a fluorine compound decomposition catalyst and a harmful compound removing catalyst are accommodated in a single reactor, wherein the decomposition catalyst is placed in an upstream portion and the harmful compound removing catalyst is placed in a downstream portion from the decomposition catalyst. This arrangement permits these catalysts to be arranged in a pile form as shown in Figs. 1, 9, and 10 of the present specification. Thereby, catalysts thus accommodated in a single reactor can be heated with a single heater.

Decomposing a harmful compound, such as SO_2F_2 , generated from the decomposition of a fluorine compound requires processing at high temperatures so that the decomposition of a fluorine compound by a fluorine decomposition catalyst is carried out. Therefore, if the temperature of a harmful compound removing catalyst is low in a decomposition process for

SO₂F₂ or a similar substance, the decomposition does not proceed. In consideration of this, the present invention uses two catalysts arranged in a pile, wherein the temperature of a harmful compound decomposition catalyst is made the same high temperature as that at which a fluorine compound decomposition catalyst works. The heating of a single reactor with a single heater enables the temperature of a harmful compound removing catalyst to be controlled to the same temperature at which a fluorine compound decomposition catalyst works. Thereby, SO₂F₂ or a similar substance is decomposed at high temperatures, with enhanced efficiency.

As mentioned above, in the present invention, two catalysts are accommodated in one reactor in a pile-arrangement as described on page 19, line 11 to line 21 in the specification. Therefore, SO₂F₂ or a similar substance generated from the decomposition of a fluorine compound is efficiently decomposed by a harmful compound removing catalyst with the presence of a not-decomposed fluorine compound.

The cited JP '418 reference, as shown in Fig. 3 and described in the related description therein, discloses that an organic halogen compound decomposition catalyst, which is to be heated to 430 °C with a heater 4, is arranged on the upstream side of one reactor tube 2; a gas containing organic halogen compounds is passed through said catalyst and decomposed; a CO oxidizing catalyst, which is to be cooling controlled to 50 to 80 °C, is arranged on the downstream side of said decomposition catalyst; and a CO gas generated from decomposition of organic halogen compound is passed

through said CO oxidizing catalyst and oxidized.

This means that, in JP '418, the CO gas generated from the decomposition of organic halogen compound is oxidized at very low temperatures of 50 to 80 °C. Therefore, heating the CO oxidizing catalyst and the organic halogen compound decomposition catalyst together cannot be applicable. In other words, such an arrangement that these two catalysts are collectively heated with one heater cannot be a practical technique, because the CO gas generated from the decomposition of organic halogen compound is cooled to be fed to the CO oxidizing catalyst. This means that such an arrangement whereby these two catalysts are placed in a pile-form, as in the present invention, is inconceivable.

Thus, the present invention substantially differs from JP '418 and is not obvious.

The JP '418 reference describes decomposition of only CO at 50 to 80 °C. However, SO_2F_2 or the like is decomposed very little at such temperature of 50 to 80 °C. The reference describes two techniques. One is that the CO gas produced from the decomposition of organic halogen compound is once cooled with water spray then heated. The other is that the CO gas is heated without cooling. Both of these techniques, however, differ substantially from the present invention.

The present invention is by one of the same inventors as the JP '418 reference. The present invention has been produced based on a new finding

such that the decomposition of a fluorine compound, which is discussed in JP '418, generates a specific harmful compound like SO_2F_2 . It is evident that the present invention would not have been invented without this new knowledge. Also, without this knowledge, neither a proper catalyst in decomposition of a decomposition product generated from decomposition of a fluorine compound, nor a proper arrangement and reaction temperature for such catalyst would have been brought about. Accordingly, it is obvious that a more efficient decomposition with improved efficiency would not be realized.

In contrast, JP '418 does not define any concrete aspect of the decomposition product generated from the decomposition of a fluorine compound discussed therein. Therefore, the reference does not suggest to introduce such a harmful compound removing catalyst as is capable of removing the above-stated harmful decomposition product generated as a consequence of the decomposition of a fluorine compound, to each a use of such catalyst, or to estimate proper reaction temperatures in such removing process.

As stated above, the present invention has been produced based on a finding that the decomposition of a fluorine compound generates a harmful compound. This new knowledge has further found a catalyst and its arrangement suitable to decompose a decomposition product generated from the decomposition of a fluorine compound, and reaction temperature being the same as the decomposition temperature of a fluorine compound. Thus, the present invention enables an efficient decomposition of a fluorine compound and its decomposition product.

The decomposition product in the JP '418 reference generated from the decomposition of a fluorine compound is not described in reference. This means that the reference does not provide any motivation, teaching or suggestion of deriving an idea of a two-stage arrangement of a catalyst and processing temperatures as are defined in the present invention. Thus, the present invention may not be derived from the teachings of the JP '418 reference.

One example of a fluorine decomposition catalyst defined in the present invention is oxides of aluminum and nickel described in claim 19. One example of a harmful compound removing catalyst in the present invention is described in claim 16 as "... contains at least one component selected from Pd, Pt, Mn, Fe, Co, Rh, Ir and Au, in the form of a metal or an oxide ..."; also in claim 17 as one catalyst selected from Pd-La, Pt-La, RH-La, Au-La, Ir-LA, Pd, Pt, Cu, Mn and CO carried on alumina and Pd-W carried on titania.

The JP '418 reference, however, does not mention a synergistic use of catalysts of a fluorine compound decomposition catalyst and a harmful compound removing catalyst. The reference simply lists single catalysts separately i.e. oxides of At and Ni, and Pt carried on alumina, each of which respectively corresponds to a fluorine compound decomposition catalyst and a harmful compound removing catalyst in the present invention.

This means that, in the JP '418 reference, although a fluorine compound is decomposed by oxides of At and Ni, nothing is discussed about the decomposition of the harmful decomposition products, such as SO₂F₂, generated therefrom. Further, what the reference mentions in

terms of Pt carried on alumina is simply a decomposition of a fluorine compound.

Thus, the present invention is not taught, suggested nor rendered obvious by the JP '418 reference.

With respect to the other two references relied upon, the EP 885648 reference discloses a process for decomposing a fluorine compound such as CF_4 , C_2F_6 , SF_6 or NF_3 using one reaction vessel. In the process, these compounds undergo a reaction at a temperature of 200-800°C with a decomposing catalyst comprised of AL in combination with at least one of Zn, NiTi, Fe, Sn, Co, Zr, Ce, Si, and Pt to produce a compound such as hydrogen fluoride or carbon dioxide.

The '648 reference, however, neither describes nor suggests that the fluorine compounds are decomposed into a harmful component comprised of any one of SO_2F_2 or N_2O using a particular catalyst charged at the upstream portion of the reaction vessel, and that the harmful component is decomposed under a reaction at a temperature of 650-850°C using a specific catalyst for removing the harmful component wherein the catalyst is charged into the reaction vessel at a portion thereof downstream from where the decomposition catalyst is charged into the reaction vessel. Thus, what is intended by the '648 reference is to decompose a fluorine compound through only one stage of a decomposition catalyst. The '648 reference does not describe or suggest any process that performs decomposition using two stages of decomposition catalyst, as the present invention specifies as now claimed.

It is noted that, through a detailed study on the decomposing reaction of fluoric compound such as SF₆ and NF₃, the inventors of the present invention have found that the decomposition of such fluoric compounds produces decomposition products only in specific combinations of SO₂F₂, N₂O, and CO. In other words, the present invention is an invention that cannot be conceived without this finding of the decomposition products.

In the present invention as now claimed, a single reactor vessel is charged with a catalyst for decomposing fluoric compound at an upstream portion thereof and with a catalyst for removing a harmful component produced in decomposition of said fluoric compound at a downstream portion thereof. Thereby, the fluoric compound is decomposed into a non-harmful substance, which is finally ready to be absorbed in water or alkaline aqueous solutions.

Therefore, the present invention as now claimed is completely different from the art defined in the '648 reference in composition and effects and is not an invention that a person skilled in the art could derive from the '648 reference.

The JP 61-3040 reference describes a gas sensor used in a gas circuit breaker filled with an insulating SF₆ gas, wherein the sensor detects fluctuation of properties of the atmospheric gas in the breaker, adapting the dependency of electrical resistance of a polymeric compound on absorption of decomposition gas thereinto. The gas sensor in the '3040 reference would not be usable at high-temperatures of 650-850°C. Thus, the art described in the '3040 reference completely differs from the present invention which is now patentable thereover as now claimed.

It is further noted that there are no suggestions in any of the references of combining them in the manner done so by the Examiner. The claims as now amended therefore are patentable over these references, taken alone or in combination.

Conclusion

In view of the foregoing amendments and remarks, Applicants contend that the above-identified application is now in condition for allowance. Accordingly, reconsideration and reexamination are respectfully requested.

To the extent necessary, Applicants petition for an extension of time under 37 CFR 1.136. Please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, or credit any overpayment of fees, to the deposit account of Mattingly, Stanger, Malur & Brundidge, P.C., Deposit Account No. 50-1417 (referencing attorney docket no. NIP-247).

Respectfully submitted,

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